

**The Value of Beef Flavor: Consumer Willingness-to-Pay for Marbling in Beef Steaks**

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### **Introduction**

In recent years, much research and discussion has focused on the decline in the demand for beef relative to pork and poultry. This decrease in demand has been attributed to several factors, including the relative price of poultry, changing consumer eating trends and overall dissatisfaction with beef as a product. Numerous surveys have revealed that consumers are not only concerned with the fat and cholesterol content of beef, but they are increasingly concerned with the quality and consistency of beef. Such concerns likely affect the purchasing behavior of consumers when buying beef.

Currently, the beef industry is trying to increase demand for beef by improving quality and consistency, thus, improving consumers' satisfaction with beef. In order to do this, the beef industry must strive to create a product that meets consumers' expectations for beef palatability. Furthermore, consumers' preferences for different palatability characteristics must be identified.

Palatability of beef and consumer taste preferences are based on three components: tenderness, flavor, and juiciness. Most of the recent research regarding consumers' palatability preferences has focused on consumers' perceptions and willingness-to-pay for tenderness (Savell et al., 1989; Morgan et al., 1992; Boleman, et al., 1997; and Lusk et al., 1999). However, recent studies have shown that beef flavor is of equal or of greater importance to consumers. Neely et al. (1998) reported that both flavor and tenderness were highly correlated with consumer overall like ratings for beef steaks. Morgan et al. (1998) stated that flavor was of greater importance than tenderness when consumers evaluated top round and top sirloin steaks. These results show that flavor is a key component of consumer satisfaction for fresh beef products.

Several aspects such as marbling level, length and type of aging, and feeding practices contribute to the flavor of beef. Marbling level clearly affects the type of flavor imparted to fresh beef products and is an obvious factor to use in order to begin studying consumer perception of beef flavor. Savell et al. (1989) found that consumers in both San Francisco and Philadelphia liked the flavor of USDA Choice beef over the taste of USDA Select beef; however, the leanness of Select beef appealed to consumers. Obviously, some consumers like the flavor of high marbled steaks, but fat content is still a significant consideration for consumers when purchasing beef. In addition, Neely et al. (1998) found that steaks in the upper two-thirds of the USDA Choice quality grade were rated significantly higher in overall like ratings than steaks of lower USDA quality grades. Consumers in Chicago and Philadelphia rated steaks graded upper two-thirds Choice significantly higher in flavor desirability. Thus, USDA quality grades and marbling clearly affect the flavor and palatability of beef.

While the studies discussed above provide information on the role of USDA quality grades in consumer evaluation of flavor, no effort was made to hold tenderness constant between different quality grades. By using steaks with similar tenderness values, one can focus on the importance of flavor alone without confounding the issue with tenderness. Determining consumer perceptions of beef flavor when tenderness is held constant could give the beef industry a better indication of the importance of beef flavor to the consumer. In addition, identification of the price premium that consumers are willing-to-pay to purchase beef having the flavor that they prefer would also be a valuable marketing tool for the beef industry.

## **Objectives**

The overall objective of this research is to identify if consumers can perceive flavor differences due to marbling in beef steaks, when tenderness is held constant, and to determine if

consumers are willing to pay a premium for their preferred flavor. The specific objectives of this paper are: 1) to analyze consumer preferences for flavor in beef steaks by comparing highly marbled USDA upper 2/3 Choice versus low marbled USDA Select; 2) to establish the price premium that consumers are willing-to-pay for their flavor preference; 3) to identify demographic variables that affect consumers' willingness-to-pay for beef flavor associated with marbling.

Before addressing the main objectives, the methodology and experimental design are briefly discussed and the demographic data and meat purchasing behavior of the sample participants are quantified.

## **Methodology**

Three basic methods are used to elicit consumer's economic value or willingness-to-pay for preferences: personal interviews, written surveys, and experimental auctions. In this study, an experimental auction market procedure was used to elicit consumer willingness-to-pay for steaks with varying flavor. Experimental auction methods are cited as having the "potential to provide more reliable measures of willingness-to-pay than a hypothetical survey method (Lusk et. al., 1999)." Fox et. al. (1995) stated four main advantages to using experimental valuation methods where winning participants are required to purchase the product: 1) auction bidding is designed to reveal true preferences, 2) the use of real money, real food, and repeated participation ensures reliability of the data, 3) the use of the requirement-to-eat factor reinforces the non-hypothetical aspect of the research and 4) the data is less biased by non-responses.

A commonly used experimental auction design is the Vickery sealed-bid, second-price auction where each participant submits a written bid on a particular product (Friedman and Sunder, 1994). The highest bidder is determined to be the "winner" of the auction and must purchase the product at the second highest bid. Second-price auctions have been used to

determine the price premium consumers were willing-to-pay for vacuum packaged steaks versus overwrapped steaks (Menkhaus et al., 1992), to determine the value of genetically modified pork (Buhr et al., 1993), to elicit consumer willingness-to-pay for food safety (Hayes et al., 1995) and to place a value on consumer preferences for various quality attributes of fresh pork chops (Melton et al., 1996).

Based on the second-price Vickery auction methodology, an experimental valuation process using a fourth-price Vickery auction was developed to elicit consumers' true willingness-to-pay for their preferred steaks. In the case of this research, the fourth highest bid determined the market price with the top three bidders required to purchase steaks at the fourth highest (market) price. The fourth-price auction ensures more auction "winners" and in the case of this research another objective (not reported in this paper) was to obtain feedback from consumers who took steaks home and consumed them.

## **Procedures**

Consumers from Chicago, Illinois and San Francisco, California<sup>2</sup> were selected and screened on a broad range of questions regarding demographics and meat eating practices. Individuals meeting the trial specifications were invited to participate in a research experiment where they would sample various New York Strip steaks. They were told that they would receive \$25 (Chicago) or \$35 (San Francisco) for their participation and that they would have the option to purchase steaks similar in quality to those they had sampled. Twenty-four taste panels consisting of twelve consumers each were scheduled for a total of 144 participants in Chicago and 144 participants in San Francisco.

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<sup>2</sup> The Chicago market is typically characterized as a Choice beef market while the San Francisco market is characterized as a Select beef market.

Once at the research facility, consumers were first paid the amount specified over the phone and were then asked to complete surveys describing their meat purchasing behavior, eating preferences, knowledge of beef and demographic characteristics. The Vickery auction process was then explained to the consumers. Participants were encouraged to bid exactly what they believed the product to be worth to them. They were informed that if they submitted a successful bid, they were obligated to purchase the steak that they bid on at the auction market price. Three practice (non-purchase) auctions were performed in order to familiarize the consumers with the auction process. Consumers were then brought into taste panel booths where they were given a warm-up sample of steak to taste and evaluate.

Consumer panelists tasted four samples from two paired sets of steaks. The two pairs were high marbled versus low marbled steaks (USDA upper two-thirds Choice versus USDA Select). Each pair of steaks had similar Warner-Bratzler shear force values, therefore, tenderness was held constant within the paired comparisons<sup>3</sup>. The steaks were all cooked to the same degree of doneness (70°C, a medium degree of doneness).

After consumers tasted each steak sample, they rated the sample on sensory traits (juiciness, tenderness, flavor and overall acceptability). Consumers were given a set of “bid sheets” where they wrote down their bid price for each steak after they had completed sensory evaluations on both steak samples in a pair. Each bid was for one pound of frozen, packaged New York Strip steaks from the same loin as the steak that they had tasted. After all of the bids were turned in for the pair, the fourth highest bid for each steak was announced as the market price. The participants knew that they had “won” an auction if they submitted a bid above the

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<sup>3</sup> Warner-Bratzler shear force measures the amount of force required to penetrate a cut of meat and allows a numerical value to be assigned indicating its tenderness level. It is the most accurate measurement of the variation in steak tenderness (Shackelford et. al., 1996).

market price. Consumers did not actually pay for the steaks until the entire auction process was complete and they had tasted, rated, and bid on all steak samples.

### **Participant Demographics**

In total, 248 consumers actually participated in the study, 124 in Chicago and 124 in San Francisco. Demographic summary statistics are provided in Table 1. Approximately 81% of the consumers participating in the study were female with slightly more male consumers participating in San Francisco. The majority of the consumers were between the ages of 35 to 54 years and the dominant ethnic background of the consumers was White/Caucasian. On average, most participants had some college education with annual household income levels around \$60,000 to \$69,000, were married and lived in households with three to four family members.

Table 2 provides the results from the purchasing behavior and consumption preferences survey questions. Fifty-eight percent of the respondents prepare and eat meat three to six times a week with Chicago consumers eating meat more times per week than San Francisco participants. Beef (63%) and chicken (27%) are the meat products that participants most prefer to consume. When consuming meat at home, participants most commonly consumed beef (65%) with chicken being the second most consumed meat (32%). The majority of the participants preferred to consume steak (76%) or roast beef (16%). Most consumers preferred to grill or to broil their steak to a medium degree of doneness, however, Chicago consumers prefer their steak more well done than San Francisco consumers.

When surveyed about their satisfaction with the flavor, tenderness and juiciness of the beef products that they consumed, 93% of the consumers were satisfied. On average, quality was marked most commonly as being the “driver” of shopping decisions, however, both price and quality appear to be important to Chicago consumers. Forty-eight percent of the participants

indicated that they typically bought USDA Choice grade steaks, 15% usually purchase USDA Select steaks and 33% did not know what quality grade they purchased. Forty-six percent of the consumers indicated that they had stopped purchasing a beef product because they were unsatisfied with the product's flavor, tenderness or juiciness.

## **Results**

Figure 1 shows the results of the sensory evaluations from the USDA Choice and USDA Select steak comparison for both Chicago and San Francisco. No significant differences in taste panel ratings were found between cities. On average, panelists ranked the flavor desirability, juiciness and overall acceptability of the high marbled steak significantly higher than the low marbled steak. Consumers also tended to perceive the Choice steak to be more tender than the Select steak (even though tenderness was held constant). These results suggest that consumers can detect significant differences in sensory traits between the two marbling categories.

After completing the sensory evaluations, participants bid on each pair of steaks. A few participants only wanted to participate in the research trial for the cash and chose not to bid on any steaks. Participants who bid zero on all steaks were eliminated from the data set leaving 226 usable participants. On average, consumers were willing-to-pay a slightly higher price for the more marbled beef steak, which they perceived to have a higher overall acceptability rating. In Chicago, these differences were valued at an additional \$.25 per pound (Table 3). Although consumers in San Francisco also found the higher marbled steaks to have a more desirable flavor, greater juiciness and higher overall acceptability, they were only willing-to-pay \$.03 more per pound.

The results discussed above are simply average taste panel rankings and bid prices. One objective of this research was to investigate if consumers exist who prefer, and are willing-to-pay

more for high marbled beef versus low marbled beef and vice versa. Based on overall acceptability rankings and bid differentials between pairs of steaks, consumers were identified who consistently preferred, and were willing-to-pay more for a particular flavor. Sixty-five consumers were consistently willing-to-pay significantly more (an average of \$1.30 per pound more) for the USDA Choice beef, 31 consumers were consistently willing-to-pay significantly more for USDA Select beef (an average of \$1.63 per pound more) and 130 participants were indifferent between USDA Choice and Select (Figure 3).

It is clear that some consumers prefer higher marbled steaks to lower marbled steaks and vice-a-versa. Each group is willing-to-pay more for their preference and those with a stronger preference generally have a larger bid differential. Can we identify consumers by their demographic traits and predict which flavor they will prefer, determine how strong their preference is, and their willingness to pay? The following equation was estimated using OLS regression procedures:

**Equation 1.**  $ABIDDIFF = f(\text{loc, gen, eth, age, edu, size, inc, eatmeat, beefeat, pref, cook, done, satisfy, drive, grade, buy})$

where  $ABIDDIFF = ((C1 - S1) + (C2 - S2))/2$

ABIDDIFF is the average bid difference between the USDA Choice steak and the USDA Select steak sample. C1 and C2 are the bids on the first (C1) and second (C2) USDA Choice samples, S1 and S2 are the bids on the first (S1) and second (S2) USDA Select samples.

ABIDDIFF is positive/negative for consumers consistently willing-to-pay more for the Choice/Select steak sample or zero for consumers who were indifferent. *Loc* is either Chicago or San Francisco, *gen* is either male or female, *eth, age, edu, size* and *inc* are the ethnic background, age, education level, family size and household income level of the participants, respectively.

*Eatmeat* is the number of times per week that meat is eaten in the home. *Beefeat* is equal to one if beef is consumed most often and is equal to zero otherwise, *pref* is the preferred type of beef to consume, *cook* is the preferred steak cooking method, *done* is the preferred degree of doneness for steaks, *satisfy* is the consumer's satisfaction with the flavor tenderness and juiciness of beef products consumed, *drive* is the factor driving shopping decisions, *grade* is the USDA grade of beef typically purchase and *buy* is where beef is typically bought.

The results from the regression analysis are shown in Table 4. The model was not very robust; the  $R^2$  value was 0.12 for Equation 1. Other functional forms, regression procedures, and demographic variables were considered with similar or poorer results. Only the *beefeat* and *inc* variables were significant ( $\alpha = .05$ ) indicating that participants who consume beef most often will bid a higher price for the USDA choice steak and as income increases, consumers tend to bid more for the higher marbled steak.

### **Summary and Implications**

These results indicate that: 1) consumers can determine a flavor difference between steaks of varying degrees of marbling when tenderness is held constant, and 2) consumers are willing-to-pay a significant premium for the steak that they prefer. Consumers who consistently preferred the upper 2/3 USDA Choice steak to the Select steak (29% of the participants) were willing-to-pay an average of \$1.30 per pound more for the Choice over the Select steak. On the other hand, those who consistently preferred the Select steak over the Choice steak (14% of the participants) were willing-to-pay \$1.63 per pound more for Select.

The results of this study should be of interest to agribusiness firms who are considering creating branded beef products. While demographic groups of consumers could not be identified, the results show that there are consumers who can distinguish a flavor difference and

are willing-to-pay a significantly higher price for their preferred flavor. Thus, it is important that consumers are properly informed of the factors affecting the palatability of their steak. As more is learned about consumer preferences for beef and as those preferences are met with the appropriate product, it is likely that demand for beef in the U.S. can be increased.

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**Table 1.** Definitions of Demographic Variables and Summary Statistics

Definition	Chicago %	San Francisco %	Overall %
Gender of Respondent:			
1 = Male	17.09	21.10	19.03
2 = Female	82.91	78.90	80.97
Age of respondent:			
1 = Under 25 years	1.71	3.67	2.65
2 = 25 – 34 years	5.13	7.34	6.19
3 = 35 – 44 years	47.86	29.36	38.94
4 = 45 – 54 years	31.62	36.70	34.07
5 = 55 – 64 years	13.68	22.94	18.14
6 = Over 64 years	0.00	0.00	0.00
Ethnic background:			
1 = White/Caucasian	94.87	74.31	84.96
2 = African American	2.56	6.42	4.42
3 = Hispanic	1.71	9.17	5.31
4 = Asian	0.85	0.92	0.88
5 = Native American	0.00	0.92	0.44
6 = Other	0.00	8.26	3.98
Education level of respondent:			
1 = Elementary school	0.00	0.00	0.00
2 = Some high school	0.85	0.92	0.88
3 = High school graduate	18.80	10.09	14.60
4 = Some college	33.33	47.71	40.27
5 = Completed junior college	11.11	16.51	13.72
6 = Completed 4-year university	24.79	17.43	21.24
7 = Completed graduate school	11.11	7.34	9.29
Household income level:			
1 = Less than \$20,000	3.48	3.81	3.64
2 = \$20,000 to \$29,000	3.48	3.81	3.64
3 = \$30,000 to \$39,999	11.30	6.67	9.09
4 = \$40,000 to \$49,999	8.70	16.19	12.27
5 = \$50,000 to \$59,999	12.17	9.52	10.91
6 = \$60,000 to \$69,999	16.52	15.24	15.91
7 = \$70,000 to \$79,999	11.30	10.48	10.91
8 = \$80,000 to \$89,999	10.43	11.43	10.91
9 = \$90,000 to \$99,999	6.09	9.52	7.73
10 = Greater than \$100,000	16.52	13.33	15.00
Number of family members living in household			
1 = 1	4.27	9.17	6.64
2 = 2	13.68	19.27	16.37
3 = 3	17.09	22.94	19.91
4 = 4	31.62	32.11	38.86
5 = 5	28.21	13.76	21.24
6 = more than 5	5.13	2.75	3.98

**Table 1. Continued** Definitions of Demographic Variables and Summary Statistics

	Chicago	San Francisco	Overall
	%	%	%
Marital Status:			
1 = Single	7.76	16.51	12.00
2 = Divorced	6.90	11.01	8.89
3 = Separated	0.86	0.92	0.89
4 = Married	83.62	67.89	76.00
5 = Widowed	0.86	2.75	1.78
6 = Domestic partnership	0.00	0.92	0.44
Employment:			
1 = Student	0.85	2.75	1.77
2 = Part-time	36.75	24.77	30.97
3 = Full-time	28.21	45.87	36.73
4 = Not employed	34.19	26.61	30.53

**Table 2.** Definitions of Meat and Beef Purchasing Behavior Variables and Summary Statistics

Definition	Chicago %	San Francisco %	Overall %
Number of times per week meat products are prepared and eaten in home.			
1 = 1-2 times	5.13	5.50	5.31
2 = 3-4 times	22.22	40.37	30.97
3 = 5-6 times	25.64	28.44	26.69
4 = 7-8 times	19.66	14.68	17.26
5 = 9-10 times	10.26	3.67	7.08
6 = more than 10	17.09	7.34	12.39
Preferred meat product for consumption:			
1 = Beef,	61.61	65.09	63.30
2 = Pork	7.14	0.00	3.67
3 = Chicken	25.00	28.30	26.61
4 = Lamb,	0.89	2.83	1.83
5 = Fish,	5.36	1.89	3.67
6 = Duck	0.00	1.88	0.92
Meat product consumed most often at home:			
1 = Beef	65.52	64.76	65.16
2 = Pork	0.00	0.95	0.45
3 = Chicken	32.76	30.48	31.67
4 = Lamb	0.00	0.00	0.00
5 = Fish	1.72	3.81	2.71
6 = Other	0.00	0.00	0.00
Preferred type of beef to consume:			
1 = Steak	73.50	79.44	76.34
2 = Ground Beef	7.69	5.61	6.70
3 = Roast	17.95	13.08	15.63
4 = Other	0.85	1.86	1.34
Preparation method for cooking beef steaks:			
1 = Broiling	23.68	27.36	25.45
2 = Grilling	65.79	56.60	61.36
3 = Pan Broiling	3.51	3.77	3.64
4 = Pan Frying	1.75	4.72	3.18
5 = Roasting	2.63	3.77	3.18
6 = Stir-Frying	0.88	1.89	1.36
7 = Braising	0.00	0.00	0.00
8 = Cooking in Liquid	1.75	1.89	1.82

**Table 2. Continued** Definitions of Meat and Beef Purchasing Behavior Variables and Summary Statistics

Definition	Chicago %	San Francisco %	Overall %
Preferred degree of doneness for steaks:			
1 = Very rare	1.71	1.85	1.78
2 = Rare	0.00	4.63	2.22
3 = Medium rare	21.37	44.44	32.44
4 = Medium	29.91	25.00	27.56
5 = Medium well	29.06	11.11	20.44
6 = Well done	15.38	6.48	11.11
7 = Very well done	2.56	6.48	4.44
Satisfaction with the flavor, tenderness, juiciness of the beef products consumed:			
1 = Extremely satisfied	5.98	6.42	6.19
2 = Very satisfied	28.21	45.87	36.73
3 = Satisfied	58.12	42.20	50.44
4 = Unsatisfied	7.69	4.59	6.19
5 = Very unsatisfied	0.00	0.92	0.44
6 = Extremely unsatisfied	0.00	0.00	0.00
Grade of beef steaks typically purchased:			
1= USDA Choice	46.96	48.62	47.77
2= USDA Select	13.91	15.60	14.73
3 = Don't know	33.91	33.03	33.48
4 = USDA Prime	0.87	1.83	1.34
5 = Other (Branded Product)	4.35	0.92	2.68
Factor "driving" shopping decisions:			
1 = Price	31.25	15.00	23.58
2 = Quality	46.43	64.00	54.72
3= Budget	10.71	8.00	9.43
4 = Health	11.61	13.00	12.26
Where beef is typically purchased:			
1 = Grocery store	86.96	75.76	81.78
2 = Butcher shop	9.57	15.15	12.15
3 = Other	3.48	9.09	6.07
Stopped purchasing beef due to dissatisfaction with product's tenderness, flavor, or juiciness:			
1 = Yes	50.86	39.81	45.54
2 = No	49.14	60.19	54.46

**Table 3.** Average Auction Bids (\$/pound) for USDA Choice versus USDA Select Beef Steaks (Standard Deviation in Parenthesis).

Treatment:	Chicago Mean (Std. Dev.)	San Francisco Mean (Std. Dev.)	Overall Mean (Std. Dev.)
High Marbled (USDA Upper 2/3 Choice)	\$2.40 (1.19)	\$2.76 <sup>a</sup> (1.46)	\$2.57 (1.34)
Low Marbled (USDA Select)	\$2.15 (1.01)	\$2.73 <sup>a</sup> (1.33)	\$2.43 (1.21)
Difference (Choice vs. Select)	\$0.25 <sup>b</sup>	\$0.03	\$0.14 <sup>b</sup>

N=226

<sup>a</sup> = Average bid is significantly different ( $\alpha = .05$ ) between locations.

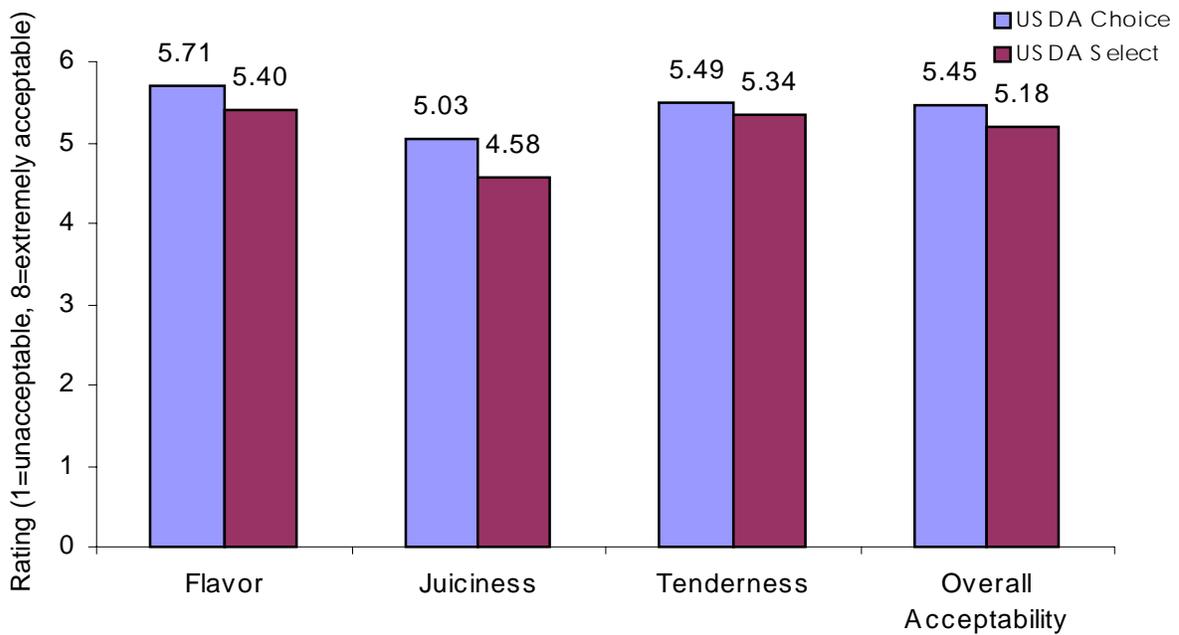
<sup>b</sup> = Average bid is significantly different ( $\alpha = .05$ ) between treatments.

**Table 4.** Regression Coefficients for USDA Choice versus USDA Select (ABDIFF) Model.

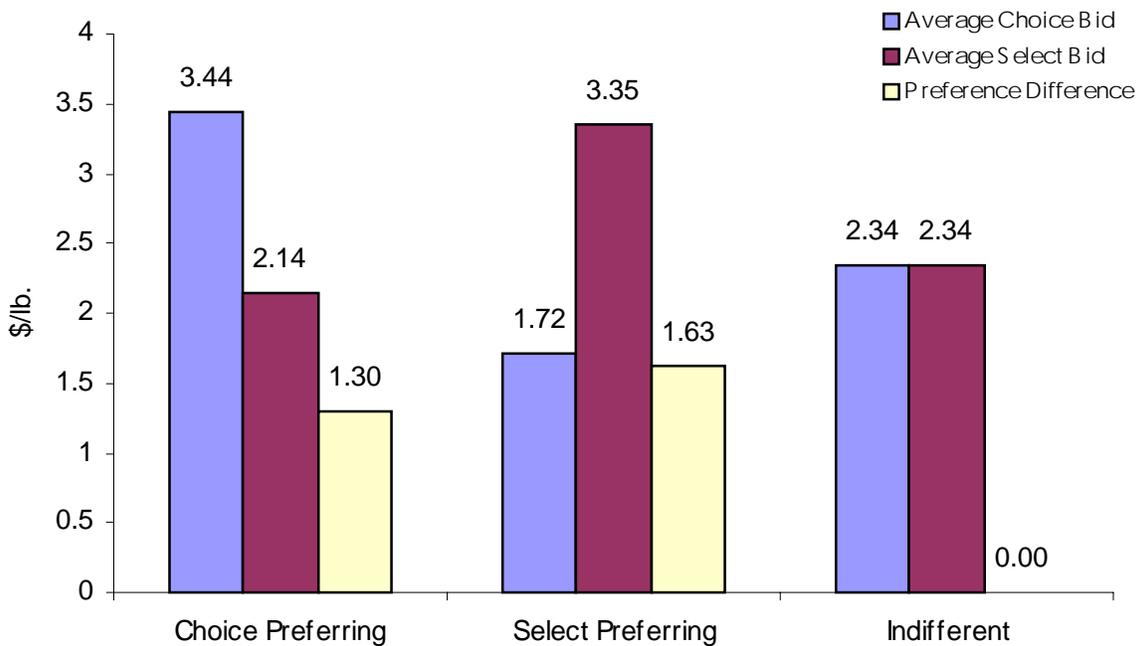
Variable	Coefficient	t statistic
Loc	-0.280	-1.381
Gen	-0.146	-0.633
Eth	0.081	0.919
Age	-0.088	-0.900
Edu	-0.010	-0.129
Size	-0.124	-1.566
Inc	0.101 <sup>a</sup>	2.654
Eatmeat	0.043	0.623
Beefeat	0.550 <sup>a</sup>	2.800
Pref	-0.001	-0.005
Cook	0.020	0.276
Done	-0.101	-1.352
Satisfy	-0.005	-0.037
Drive	-0.022	-0.204
Grade	0.036	0.473
Buy	0.031	0.287

<sup>a</sup> = coefficient is statistically significant at the 5% level

n=188; R<sup>2</sup> = .12



**Figure 1.** Taste Panel Ratings for USDA Upper 2/3 Choice and Select Beef Steaks



**Figure 2.** Average Bids for Preferred Beef Flavor (USDA Upper 2/3 Choice versus USDA Select Beef Steaks)